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Reg. No……
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DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/ MANAGEMENT/COMMERCIAL PRACTICE, APRIL – 2023

THERMAL ENGINEERING

[Maximum Marks: **100**] [Time: **3** Hours]

PART-A

[Maximum Marks: **10**]

I. (Answer ***all*** questions in one or two sentences. Each question carries ***2*** marks)

1. Define a system.
2. Explain Boyle's law.
3. Define air standard efficiency of a cycle.
4. Define indicated power.
5. Define thermal conductivity. (5 x 2 = 10)

PART-B

[Maximum Marks: **30**]

II. (Answer ***any five*** of the following questions. Each question carries ***6*** marks)

1. State the Clausius and Kelvin-Planck statements of second law of thermodynamics?.
2. Classify thermodynamic system with example.
3. Illustrate Carnot cycle with P-V and T-S diagrams.
4. Define the terms i) Mechanical efficiency ii) Indicated thermal efficiency ii) Relative efficiency.
5. List any six uses of steam.
6. Explain with example various modes of transmission of heat.
7. State any six uses of compressed air. (5 x 6 = 30)

PART-C

[Maximum Marks: **60**]

(Answer ***one*** full question from each Unit. Each full question carries **15** marks)

UNIT – I

III. a. Derive the characteristic equation of a perfect gas. (7)

b. 0.2 m^3 of gas at 1 bar and 100° C is compressed adiabatically to 0.05 m^3. Determine (i) The mass of gas compressed (ii) Final pressure and temperature of gas (iii) Increase in internal energy. Take γ=1.4 and R= 295 J/kgK. (8)

OR

IV. a. Derive the expression for workdone during isothermal expansion process. (7)

b. l kg of an ideal gas is heated from 20° C to 100° C assuming, R=264 J/kgK and γ = 1.18 for the gases. Find (i) Specific heat at constant pressure and volume (ii) Change in internal energy (iii) Change in enthalpy. (8)

UNIT – II

V. a. Derive the expression for air standard efficiency of Otto cycle. (7)

b. A Carnot cycle works with isentropic compression ratio of 5 and the maximum temperature is limited to 550K. Compute the minimum temperature in the cycle and air standard efficiency of the cycle. Take ratio of specific heats as 1.4. (8)

OR

VI. a. With the help of a neat sketch explain the valve timing diagram of a four stroke cycle petrol engine. (7)

b. 1 kg of air at temperature of 15°C and pressure of 100 kPa is taken through a Diesel cycle. The compression ratio is 15 and the heat added is 1850 kJ. Calculate the ideal cycle efficiency. (8)

UNIT- III

VII. a. Derive the expression of velocity of steam leaving a nozzle. (7)

b. A two cylinder 4-stroke cycle I.C engine is to be designed to develop 15kW IP at 1200 rpm. The m.e.p of the cycle is limited to 600kPa. Determine the bore diameter, and stroke of the engine if stroke = 1.2 x bore diameter. (8)

OR

VIII. a. Explain with neat diagram, the working of a simple double acting steam engine. (7)

b. How much heat is needed to convert 5 kg of water at 40°C into 90% dry steam at 5 bar? Take specific heat of water as 4.187 KJ/kgK. (8)

UNIT - IV

IX. a. Derive an expression for the conduction of heat through a plane composite wall. (7)

b. Heat is conducted through a composite plate composed of two parallel plates of different materials A and B of thermal conductivities 134 W/mK and 60 W/mK and thickness 36 mm and 42 mm respectively. The temperature of outer surface of slab A and B are 96°C and 8°C respectively. (8)

OR

X. a. Explain the working of single stage reciprocating compressor with neat sketch. (7)

b. A single acting single stage air compressor is required to compress 1 kg of air from 100 kPa to 400 kPa. The initial temperature is 27°C. Calculate the power required to drive the compressor for the isothermal compression process, if the speed is 100 rpm. Assume characteristic gas constant as 0.287 kJ/kgK. (8)

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